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EPIDEMIOLOGY

Alcohol Abuse/Dependence Symptoms Among Hospital Employees Exposed to a SARS Outbreak

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Abstract — Aims: The aim of this study was to examine alcohol abuse/dependence symptoms among hospital employees exposed to a severe acute respiratory syndrome (SARS) outbreak, and the relationship between types of exposure to the SARS outbreak and subsequent alcohol abuse/dependence symptoms. **Methods:** A survey was conducted among 549 randomly selected hospital employees in Beijing, China, concerning the psychological impact of the 2003 SARS outbreak. Subjects were assessed on sociodemographic factors and types of exposure to the outbreak, and on symptoms of post-traumatic stress (PTS), alcohol abuse/dependence and depression. **Results:** Current alcohol abuse/dependence symptom counts 3 years after the outbreak were positively associated with having been quarantined, or worked in high-risk locations such as SARS wards, during the outbreak. However, having had family members or friends contract, SARS was not related to alcohol abuse/dependence symptom count. Symptoms of PTS and of depression, and having used drinking as a coping method, were also significantly associated with increased alcohol abuse/dependence symptoms. The relationship between outbreak exposure and alcohol abuse/dependence symptom count remained significant even when sociodemographic and other factors were controlled for. When the intrusion, avoidance and hyperarousal PTS symptom clusters were entered into the model, hyperarousal was found to be significantly associated with alcohol abuse/dependence symptoms. **Conclusions:** Exposure to an outbreak of a severe infectious disease can, like other disaster exposures, lead not only to PTSD but also to other psychiatric conditions, such as alcohol abuse/dependence. The findings will help policy makers and health professionals to better prepare for potential outbreaks of diseases such as SARS or avian flu.

INTRODUCTION

The severe acute respiratory syndrome (SARS) epidemic of 2003, with its rapid spread and high mortality rate, caused considerable panic and anxiety around the world (Chong *et al*., 2004). It spread to more than 25 countries, and has been described in the mental health literature as a 'bio-disaster' (Chong *et al*., 2004), comparable, in its psychological impact, to other disasters, such as earthquakes and terrorist attacks. Beijing was among the cities most severely affected by the epidemic (WHO, 2003). In the affected countries, health care workers acted as first responders to the SARS outbreaks in their local areas, and many of them were charged with caring for patients with the disease. Because they worked with and around SARS patients, these health care workers were also especially vulnerable to being infected with the disease. More than 20% of all the individuals who contracted SARS were health care workers (WHO, 2003). Given their relatively intensive involvement with the epidemic, it is likely that they suffered from higher levels of associated psychological stress and trauma, compared to other groups within their communities.

Numerous studies have found evidence for elevated rates of post-traumatic stress disorder (PTSD) in populations and groups exposed to disasters (Norris *et al*., 2002; Galea *et al*., 2005), including war and combat (McFall *et al*., 1992). Disaster exposures have also been found to be positively related to subsequent rates of alcohol abuse and dependence in some studies, particularly those examining communities affected by volcanic eruptions, terrorist attacks and industrial accidents (Adams and Adams, 1984; Joseph *et al*., 1993; Smith *et al*., 1999; Grieger *et al*., 2003; Vlahov *et al*., 2004a; Boscarino *et al*., 2006), and soldiers with combat exposure (Fischer, 1991; Herrmann and Eryavec, 1996). In other disaster studies, however—often those examining the effects of natural disasters such as floods and earthquakes—these events have apparently led to decreases in alcohol use or have seemed not to affect rates of alcohol use and abuse (Ullman and Newcomb, 1999; Shimizu *et al*., 2000; North *et al*., 2004; Simons *et al*., 2005). The inconsistencies in these findings underscore the importance of improving our understanding of the particular circumstances under which alcohol use behaviours may be affected by disaster exposures.

Individuals who experience prolonged or repeated exposure to one or more traumatic events are more likely, compared to those with fewer or briefer traumatic exposures, to develop PTSD (Kaysen *et al*., 2003). They may also be more likely to develop alcohol abuse or dependence (McFarlane, 1998). Relatively high rates of alcohol abuse and dependence have been found among firefighters and rescue workers with years of service in their professions (North *et al*., 2002), and among those who have suffered major personal losses, such as loss of their homes, as a result of fires they were involved in fighting (McFarlane, 1998). Studies of war veterans have concluded that combat exposure intensity can affect subsequent rates of alcohol abuse and dependence (Fischer, 1991; Herrmann and Eryavec, 1996).

Many studies examining PTSD and alcohol abuse have found evidence for a relationship between PTSD and post-disaster rates of alcohol abuse (Adams and Adams, 1984; Keane and Wolfe, 1990; Kulka *et al*., 1990; McFarlane, 1998; Grieger *et al*., 2003; Stewart *et al*., 2004; Simons *et al*., 2005; Adams *et al*., 2006). In other studies, however, no evidence for such a relationship was found (Vlahov *et al*., 2004b; Boscarino *et al*.,

2006). It is likely that a variety of individual-level and other factors, including genetic ones, also play a part in determining the alcohol use outcomes of individuals affected by disasters (Kofoed *et al*., 1993; McFarlane, 1998). Demographic factors have frequently been found to be significantly associated with patterns of alcohol use and abuse (Michalak *et al*., 2007). A survey conducted in China during 1993–1994 found alcohol dependence status to be significantly related to gender, age, educational status and income level, but not to marital status (Hao *et al*., 1998; Zhang *et al*., 2004). Studies done in the United States and Great Britain, on the other hand, have found significantly lower rates of alcohol abuse among married people as compared to those who are single or divorced (Leonard and Rothbard, 1999; Power *et al*., 1999). These five factors were taken into account in the analyses described below.

Previous studies on the SARS epidemic have examined related PTS symptoms and other psychiatric morbidity, among health care workers in affected areas (Chong *et al*., 2004; Liu *et al*., 2004; Maunder *et al*., 2004; Nickell *et al*., 2004; Yang *et al*., 2004; Zhao *et al*., 2004; Ho *et al*., 2005; Koh *et al*., 2005; Phua *et al*., 2005; SARS Commission, 2006; Wu *et al*., 2007). To our knowledge, however, no studies have yet examined the impact of their exposure to the SARS epidemic on their subsequent alcohol use behaviours. The present paper aims to fill in some of the gaps in our understanding of alcohol use outcomes among hospital employees exposed to a major infectious disease outbreak, and the factors affecting these outcomes. It examines (1) alcohol abuse/dependence symptoms among hospital employees who were exposed to a SARS outbreak, (2) the relationship between types of exposure to the SARS outbreak and subsequent alcohol abuse/dependence symptoms and (3) the relationship between PTS symptoms and alcohol abuse/dependence symptoms among these hospital employees, controlling for sociodemographic factors.

METHODS

Sample

A stratified random sample of 662 hospital employees was selected from among the employees of a major hospital in Beijing (anonymity requested) that had been affected by the 2003 SARS outbreak. The total employee population of the hospital was ∼3000. The survey took place in 2006. Five hundred forty-nine employees participated in the study, for a response rate of 83%. Using hospital employee rosters, individuals were randomly selected for recruitment into this study based on a stratification strategy designed to provide a representative sample of the health care staff and professionals of the entire hospital. The sample was stratified by profession (doctor, nurse and administrative/other hospital staff), and age (under 35, 35–55, and 56 and older), as well as exposure status. High job-related (work) exposure during the 2003 SARS outbreak was defined as working in units with frequent and intense contact with SARS patients, such as SARS wards, fever clinics, the Department of Infectious Diseases, the Emergency Room, etc. Doctors and nurses working in units with high exposure to SARS patients were oversampled. Those aged 35–55 were also oversampled, for reasons related to a second planned study of the children of hospital employees exposed to these events. (The current paper, however, focuses only on the hospital employees themselves.) Each of the 549 participants completed a self-report questionnaire. This study was carried out in full compliance with institutional review board requirements. Written informed consent was obtained from all participants prior to participation in the study. Data were weighted to obtain statistics representative of the entire hospital population. A weight proportional to the inverse of the probability of study inclusion of members of a given sampling stratum, was assigned to that stratum. The sampling weights were used in all the analyses, for valid statistical inference.

Measures

Alcohol abuse/dependence symptoms. Hospital employees were asked about their use of alcohol in the past 12 months. Seven questions regarding alcohol abuse/dependence symptoms, adapted from the National Household Survey on Drug Abuse (NHSDA) (SAMHSA, 2001), were used, covering (a) spending a great deal of time on obtaining alcohol, (b) drinking more than intended, (c) building up a tolerance for alcohol, (d) giving up or spending less time doing important things such as working, going to school, taking care of children, doing fun things or spending time with friends or family, because of drinking, (e) drinking alcohol even though drinking was causing one to have problems with emotions, nerves or mental health, (f) alcohol use causing or exacerbating any physical health problems and (g) wanting to cut down on alcohol use. The symptom count of alcohol abuse/dependence symptoms was used in our analyses.

The psychological impact of the SARS outbreak. The IES-R (Impact of Event Scale—Revised) (Weiss and Marmar, 1997) is a self-report measure assessing subjective distress resulting from a traumatic life event. It was used to assess PTS symptoms experienced by the subjects during the 3-year period following the SARS outbreak. The IES-R has 22 items, each with a Likert rating scale from 0 to 4. The instrument has been translated into, and validated in, Chinese (Chong *et al*., 2004); a score of 20 or more was interpreted here—as suggested by previous studies of populations affected by traumatic events (Feinstein *et al*., 2002; Hawryluck *et al*., 2004)—to indicate a high level of PTS symptoms. The IES-R also contains three subscales for the following PTSD symptom clusters: intrusion, avoidance and hyperarousal (corresponding to the DSM-IV B, C and D criteria for PTSD diagnosis). Scores on each subscale range from 0 to 4 (Weiss, 2004). For the current study, a score of 0.8 or higher on any of the three symptom cluster subscales was considered a high score on that subscale.

Depression. The CES-D (Center for Epidemiologic Studies Depression Scale) was used as a measure of depression (Radloff, 1977). The Chinese version of the CES-D has been validated through a considerable amount of research in Chinese populations (Xin and Shen, 1997; Cheung and Bagley, 1998). A CES-D score of 16 or over, the cut-off point used in most studies, indicated the presence of depressive symptomatology.

Direct exposure to the SARS outbreak. Information about different types of exposure to the SARS outbreak was collected directly from hospital employees. Measures of direct exposure include work-related exposure (work exposure) and any quarantining. Work exposure was defined as working in a high-risk

location, such as the Department of Infectious Diseases, the Department of Pulmonary Medicine or a SARS ward, fever clinic, Emergency Room or X-ray Lab, during the outbreak period, defined as January to June 2003. Any quarantining was defined, based on six questionnaire items, as having been quarantined due to being diagnosed with SARS or suspected SARS, or to having had direct contact with SARS patients either at work, at home or in other places. Information was also obtained as to whether any of a respondent's family members or friends had developed SARS, and either died from or recovered from it. The resulting measure was labelled 'Relative or Friend got SARS'.

TV exposure. Health Care Workers were asked about the amount of time they had spent viewing news coverage of the SARS outbreak on television. A response reporting watching 'a lot' (versus 'some' or 'none') of such coverage, during the SARS outbreak, was counted as positive.

Other exposure to traumatic events. Subjects were asked about exposure to potentially traumatic events prior to and following the SARS outbreak, including severe injury in violent circumstances, witnessing a death or serious injury of a close friend or family member, and living through a war or a major disaster. This instrument was modified from a six-item questionnaire used in trauma exposure surveys conducted in the United States (Saltzman *et al*., 1999; Hoven *et al*., 2005). A summary variable used in the analyses, 'Other Traumatic Events', was coded as 1 if any of these responses were positive.

Coping. Subjects were also asked about whether, during the SARS outbreak, they had used any of the following methods to help them cope with experiences and feelings related to the outbreak: keeping to a regular routine at home and work; telling myself things will be better; watching TV, or reading more than before; learning as much as possible about SARS; crying, screaming, yelling or getting angry; meditating or practicing yoga/qi gong, deep breathing or aerobic sports; drawing or painting, or writing stories or poems, or composing music; doing volunteer work; using alcohol; smoking cigarettes; or praying. The analyses for the current paper made use of subjects' responses regarding one of these coping methods, i.e. alcohol use.

Sociodemographics. Information about subjects' age, gender, marital status, educational level and family income was also obtained in the survey.

Statistical analyses

Summary statistics were obtained to describe the characteristics of the study sample. Because of the observed characteristics of the outcome variable, generalized linear modelling for data with variances proportional to means was used to assess the relationships of sociodemographic variables and specific risk factors, with the outcome variable (i.e. past year alcohol abuse/dependence symptom count). In the models, a logarithmic function was used to link mean alcohol symptom count outcomes to a predictor or a linear combination of a given set of predictors, such that the model coefficient of a predictor was the log ratio of the change in the outcome variable per unit change in the predictor, with a zero coefficient for no association between the outcome and the predictor. The SAS (version 9.1.3) procedure PROC GENMOD was used for these analyses. To aid interpretation, the covariate-adjusted ratio of the outcome means, for two levels of the predictor, was calculated for each predictor.

These models were first used to examine the relationship between each sociodemographic or other risk factor, and the outcome variable. Subsequently, a model with multiple predictors was used to examine the simultaneous effects of the various exposure variables, with the sociodemographic variables controlled for.

The regression analyses were conducted in four steps. In the first step (Model 1), the various exposure variables were included in the analysis, with the sociodemographic factors controlled for. In Model 2, the binary PTS symptom level variable was entered into the equation, in order to examine its association with alcohol abuse/dependence symptom count, controlling for the other factors in the model. We were also interested in examining the changes in the associations between the exposure variables and alcohol abuse/dependence symptom counts that might occur after controlling for PTS symptom level. Attenuation in these associations could indicate that the impact of outbreak event exposure on hospital employees' alcohol abuse/dependence symptoms was mediated through their PTS symptom levels. In Model 3, the three variables representing the PTSD symptom clusters were entered into the equation, in order to examine and compare their specific relationships with the alcohol abuse/dependence symptom count outcome variable. In the last step (Model 4), we added the CES-D-based depression measure into the equation, in order to examine the associations of PTS symptoms and depression with alcohol abuse/dependence symptoms. Sampling weights were used in all analyses.

RESULTS

Sample description

Twenty-one percent of the study sample were doctors, 38% nurses, 22% technicians and 20% had administrative and other positions. About 76% were female. About 69% of the sample reported having used alcohol in the year prior to the study. Nineteen percent had been quarantined during the SARS outbreak, 25% had worked in locations where contact with SARS patients was common, 9% had family members or friends who contracted SARS and 10% had high PTS symptoms (Table 1). About 6% reported having used alcohol to cope with unpleasant feelings experienced during the outbreak.

The number of alcohol abuse/dependence symptoms reported for the past year was used as the outcome variable in our analyses. In this sample, the alcohol symptom counts ranged from 0 to 6, with a mean of 0.24 (SD = 0.70). About 19% of the hospital employees had at least one alcohol-related symptom, while <5% had two or more symptoms. The alcohol symptom count variable had a skewed distribution, with variances tending to increase with the means. As shown in Table 1, relatively high mean alcohol abuse/dependence symptom counts were found for men, those between the ages of 36 and 50, those with lower educational levels and those with upper-middle level family income levels (of 40,000–69,999 RMB per year). Alcohol symptom counts were also high among those who had worked in units with high levels of exposure to SARS patients, and among those who had been quarantined during the SARS outbreak. Alcohol symptom counts

Table 1. Alcohol abuse/dependence symptoms and related factors ($N = 549$)

Factors	Weighted percent (%)	Alcohol symptoms mean (SD)[a]	Unadjusted mean ratio (95% CI)[b]	Model 1 Adjusted mean ratio (95% CI)	Model 2 Adjusted mean ratio (95% CI)	Model 3 Adjusted mean ratio (95% CI)	Model 4 Adjusted mean ratio (95% CI)
Sociodemographic factors							
Gender							
Female	76.5	0.17 (0.51)	1	1	1	1	1
Male	23.5	0.65 (1.13)	3.72 (2.50, 5.54)	2.70 (1.75, 4.17)	2.62 (1.70, 4.03)	3.06 (1.99, 4.69)	3.25 (2.08, 5.06)
Age (years)							
≤35	33.8	0.20 (0.75)	1	1	1	1	1
36–50	47.1	0.35 (0.74)	1.71 (1.03, 2.85)	1.50 (0.87, 2.58)	1.53 (0.89, 2.63)	1.35 (0.79, 2.31)	1.34 (0.78, 2.32)
>50	19.1	0.29 (0.69)	1.41 (0.74, 2.68)	1.48 (0.77, 2.82)	1.63 (0.85, 3.12)	1.67 (0.88, 3.17)	1.69 (0.87, 3.26)
Marital status							
Single	11.8	0.22 (0.63)	1	1	1	1	1
Married	84.1	0.30 (0.75)	1.34 (0.64, 2.82)	0.61 (0.30, 1.24)	0.58 (0.29, 1.18)	0.57 (0.28, 1.14)	0.60 (0.29, 1.21)
Divorced/separated	4.1	0.21 (0.45)	0.96 (0.24, 3.91)	0.56 (0.16, 1.96)	0.53 (0.15, 1.82)	0.51 (0.15, 1.72)	0.46 (0.13, 1.58)
Education							
≤high school	35.0	0.40 (0.99)	1	1	1	1	1
>high school	65.0	0.23 (0.56)	0.56 (0.37, 0.85)	0.64 (0.44, 0.94)	0.64 (0.44, 0.93)	0.71 (0.48, 1.04)	0.68 (0.46, 1.00)
Household income							
<20,000	16.1	0.20 (0.66)	1	1	1	1	1
20,000–39,999	27.4	0.21 (0.55)	1.04 (0.47, 2.27)	1.60 (0.81, 3.18)	1.60 (0.81, 3.17)	1.56 (0.79, 3.08)	1.76 (0.87, 3.55)
40,000–69,999	31.3	0.43 (0.93)	2.18 (1.09, 4.38)	3.25 (1.76, 6.00)	3.20 (1.74, 5.90)	3.16 (1.71, 5.85)	3.32 (1.77, 6.23)
≥70,000	25.2	0.25 (0.63)	1.23 (0.57, 2.67)	2.31 (1.16, 4.62)	2.10 (1.05, 4.20)	2.05 (1.03, 4.12)	2.13 (1.05, 4.32)
Exposures and coping during the SARS Outbreak							
Any quarantining							
No	81.2	0.26 (0.68)	1	1	1	1	1
Yes	18.8	0.42 (0.93)	1.64 (1.02, 2.65)	2.20 (1.32, 3.66)	2.09 (1.25, 3.50)	2.06 (1.22, 3.47)	1.84 (1.06, 3.19)
Work exposure							
No	75.4	0.25 (0.67)	1	1	1	1	1
Yes	24.6	0.41 (0.90)	1.68 (1.07, 2.62)	1.75 (1.10, 2.78)	1.70 (1.06, 2.72)	1.57 (0.98, 2.54)	1.62 (0.99, 2.66)
Relative or friend got SARS							
No	91.1	0.27 (0.74)	1	1	1	1	1
Yes	8.9	0.42 (0.70)	1.54 (0.81, 2.93)	1.23 (0.71, 2.12)	1.07 (0.61, 1.88)	0.87 (0.48, 1.58)	0.85 (0.46, 1.55)
TV exposure							
No	21.8	0.32 (0.74)	1	1	1	1	1
Yes	78.2	0.28 (0.74)	0.86 (0.52, 1.42)	0.93 (0.60, 1.44)	0.94 (0.61, 1.45)	0.93 (0.60, 1.44)	0.92 (0.59, 1.42)
Drank to cope:							
No	94.2	0.22 (0.58)	1	1	1	1	1
Yes	5.8	1.39 (1.89)	6.38 (4.12, 9.88)	4.93 (3.01, 8.08)	4.71 (2.89, 7.67)	4.65 (2.86, 7.57)	4.90 (3.00, 8.02)
Other Traumatic Experiences (before or after SARS)							
Other Traumatic Events							
No	83.0	0.27 (0.71)	1	1	1	1	1
Yes	17.0	0.36 (0.85)	1.35 (0.80, 2.27)	1.23 (0.79, 1.91)	1.27 (0.82, 1.97)	1.28 (0.82, 1.97)	1.24 (0.80, 1.93)
Psychopathology							
High PTS symptoms							
No	89.9	0.25 (0.66)	1		1		
Yes	10.1	0.58 (1.16)	2.29 (1.36, 3.86)		1.65 (1.02, 2.66)		
High intrusion score							
No	85.6	0.20 (0.54)	1			1	1
Yes	14.4	0.50 (1.05)	2.20 (1.36, 3.54)			0.90 (0.49, 1.64)	0.96 (0.54, 1.70)
High avoidance score							
No	84.0	0.24 (0.61)	1			1	1
Yes	16.0	0.53 (1.18)	2.22 (1.42, 3.48)			0.88 (0.50, 1.53)	0.79 (0.45, 1.39)
High hyperarousal score							
No	89.6	0.23 (0.59)	1			1	1
Yes	10.4	0.76 (1.49)	3.32 (2.13, 5.17)			3.48 (1.81, 6.69)	3.10 (1.63, 5.88)
Depression: (CES-D ≥ 16)							
No	77.2	0.24 (0.67)	1				1
Yes	22.8	0.44 (0.91)	1.82 (1.16, 2.86)				1.71 (1.10, 2.64)

[a]SD = standard deviation
[b]CI = confidence interval.

among hospital employees reporting that they drank to cope during the SARS outbreak were six times as high as among those not reporting drinking to cope. Finally, the alcohol symptom counts of hospital employees with high PTS symptoms were, on average, more than twice as high as those of hospital employees without high PTS symptoms. The relationship between depression and alcohol symptom count appeared to be similar to that between PTS symptom level and alcohol symptom count.

In the first multivariate analysis, with multiple exposure variables and sociodemographic factors included (Table 1, Model 1), the results indicated that, with the demographic variables controlled for, having been quarantined during the SARS outbreak, and having worked in a high-risk location, were the two types of exposure that were significantly associated with higher alcohol symptom counts. Having used alcohol drinking as a coping method was also significantly associated with alcohol abuse/dependence symptoms 3 years later.

As mentioned above, a significant association was found, in bivariate analyses, between alcohol symptom counts and levels of PTS symptoms. High PTS symptoms were also associated with several types of SARS-related event exposures, including having been quarantined [OR = 3.47, 95% CI = (1.93, 6.25), $P < 0.0001$], having worked in a high-risk location [OR = 3.11, 95% CI = (1.76, 5.49), $P < 0.0001$] and having had family members or friends who developed or died from SARS [OR = 3.74, 95% CI = (1.83, 7.62), $P = 0.0003$]. Further investigation was called for, then, into the question of whether the associations between the exposure variables and alcohol symptom counts could be partially explained by high PTS symptom levels. To find it out, we extended Model 1 by adding an indicator variable for high post-exposure PTS symptom levels. The results of this analysis (Model 2) did indicate a positive association between post-exposure PTS symptom levels and alcohol symptom counts; however, the associations between the exposure variables and alcohol symptom counts remained essentially unchanged after introducing PTS symptom levels into the model. In both models, any quarantining and work exposure were each significantly associated with the outcome variable.

To understand how the three PTS symptom clusters (intrusion, avoidance and hyperarousal) each relate to alcohol symptom count, we entered these three variables into the equation in Model 3. The results showed that, with all of the exposure variables and sociodemographic factors controlled for, hyperarousal was the only PTS symptom cluster that was significantly associated with alcohol symptom count. Work exposure was no longer significantly associated with the outcome variable, suggesting that the effects of direct event exposure on alcohol symptoms may be mediated by symptoms of hyperarousal.

In the final model (Model 4), the depression measure was added in, and it was found to be significantly associated with alcohol abuse/dependence symptoms; however, the effects of hyperarousal and any quarantining remained significant. Among the sociodemographic factors, male gender and high household income were found to be significantly associated with the outcome variable. This four-step regression procedure was repeated using a sub-sample consisting of past-year alcohol users only, and the results were similar (results not shown).

DISCUSSION

This paper examines alcohol abuse/dependence symptoms 3 years after Beijing's 2003 SARS outbreak, among hospital employees who lived through the outbreak. It is the first to examine the mental health impacts of an outbreak of a rapidly spreading infectious disease on the outbreak's first responders, in terms of their symptoms of alcohol abuse/dependence as well as their PTS symptoms.

Our findings indicate a relationship between exposure to the SARS outbreak and alcohol abuse/dependence symptoms 3 years later, in hospital employees. We examined alcohol abuse/dependence symptoms in relation to several types of outbreak event exposures, including exposure to SARS patients at work, being quarantined, the death or illness of a relative or friend from SARS and exposure to media coverage of the outbreak. Pre- and post-outbreak exposures to other traumatic events were also taken into account in our analyses. Our results indicate that the disaster's impact on alcohol problems in these hospital employees differed according to the types of exposures they had experienced. Being quarantined, and working in locations where exposure to SARS patients was common, were significantly associated with later alcohol abuse/dependence symptoms. Other types of exposures, such as having had family members or friends contract SARS or die from SARS, and exposure to media coverage of the outbreak, were not significantly associated with later alcohol abuse/dependence symptom counts. These findings highlight the fact that the possible mental health consequences of a disaster are not limited to PTS symptoms, and may be long-lasting.

It is interesting to note that a comparison can be made between our findings regarding alcohol symptoms among hospital employees in Beijing, and Fischer's (1991) findings regarding substance abuse among American veterans of the war in Vietnam. During the months-long period of Beijing's SARS outbreak, hospital employees were likely to experience a sense of danger both at the workplace and outside it, since the threat of deadly infection loomed throughout the city and the surrounding area (Yang *et al*., 2004). To examine the effect of high work exposure on the alcohol use outcomes of individual hospital employees, we in effect compared outcomes between hospital employees with relatively intense exposure to a prolonged period of high stress and those with less intense exposures.

Fischer's study of Vietnam veterans similarly compared substance use outcomes between soldiers with relatively intense exposure to a (very) prolonged period of high stress, and those with less intense exposures. His study found higher rates of substance abuse among Vietnam veterans who experienced heavy combat, compared to other Vietnam veterans, providing evidence of a dose–response relationship between combat exposure and later substance abuse (Fischer, 1991). Our findings, similarly, indicate that, among hospital employees in Beijing, a dose–response relationship may exist between intensity of exposure to the SARS outbreak disaster and later symptoms of alcohol abuse and dependence.

We also examined the role of PTS symptoms in the relationship between exposure to the SARS outbreak and subsequent alcohol abuse/dependence symptoms. It was not surprising to find that PTS symptoms were significantly associated with alcohol abuse/dependence symptoms. Our Model 2 results also showed that, with PTS symptom levels controlled for, having

been quarantined and having worked in a high-risk location during the SARS outbreak were still significantly associated with later alcohol abuse/dependence symptoms. These findings suggest that exposure to the SARS outbreak may have impacted hospital employees' drinking behaviours not only directly but also indirectly by way of their PTS symptoms. Consistent with previous studies (Stewart *et al*., 1998), our study found, in multivariate analyses, that among the three PTSD symptom clusters—intrusion, avoidance and hyperarousal—only hyperarousal was significantly associated with alcohol abuse/dependence symptoms. Depression was also independently associated with alcohol abuse/dependence symptoms in this sample. However, more, ideally longitudinal, studies are needed to further our understanding of the possible pathways.

Levels of reported alcohol abuse/dependence symptoms were fairly low on average, in this sample. This is not surprising, considering that general per capita alcohol consumption was recently estimated to be ∼4.5 L of pure alcohol per year (Hao *et al*., 2004), a rate just over half that found in the United States, and considerably lower than the rates found for most European countries (WHO, 2004). The general prevalence of alcohol dependence in China was estimated at 3.8% (Hao *et al*., 2004). Hospital employees with higher income levels were found to have higher mean alcohol symptom counts than those with lower incomes here, a finding parallel to those of a number of community studies done in the United States (Grant, 1997; Parker *et al*., 1995; Keyes and Hasin, 2008).

This study is, in general, limited by its cross-sectional nature; no causal relationships can be established based on its findings. Information on the hospital employees' pre-SARS alcohol use patterns was not collected, so no direct comparisons could be made between alcohol use behaviours before and after the outbreak. We cannot be sure whether or not the post-SARS alcohol abuse/dependence symptoms that these individuals reported were new symptoms, which developed after the outbreak began (North *et al*., 2004). The low mean alcohol symptom count found in this sample also placed some limitations on the statistical power of our analyses. The study is also limited by its use of an instrument measuring levels of alcohol abuse/dependence symptoms only. No definitive alcohol abuse or dependence diagnoses could be made. Finally, some of the individuals who had been employed at the hospital during the SARS outbreak were no longer working there at the time of the survey, 3 years later, and were not included in the sample. Only a very small number had left—<2% of the employee population—but these individuals' reasons for leaving are unknown, and the extent to which this may have biased our results is also unknown. However, the findings of this study do provide valuable information for policy makers and mental health professionals on the impact of an infectious disease outbreak on first responders' drinking behaviours, information that will be of use in preparing to respond to possible future outbreaks of infectious disease.

As McFarlane (1998) has pointed out, there is some evidence that alcohol use can, at least in the short term, be an effective remedy for emotional stress, and in some cases may even help to prevent some symptoms of PTSD from developing (McFarlane *et al*., 1997; McFarlane, 1998). Alcohol abuse, however, can greatly increase an individual's risk of being involved in, for example, an automobile accident (Cottler *et al*., 1992), and heavy alcohol use can, in the long term, lead to serious health problems. To the extent that heavy alcohol use can be discouraged among members of a group that is placed under extreme stress, and that safe and effective alternative methods of stress reduction can be made available to them, this should of course be done. Such programs or services might help to prevent members of the group from developing alcohol abuse and dependence, and would be likely to have other benefits as well.

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